Gigabit Ethernet

Pentium® Pro Cluster Workshop

- Introduction
- Drivers
- How it works
- Status of the standard
- Products & cost

John L. Payne

JLP Associates/Packet Engines

April 10, 1997

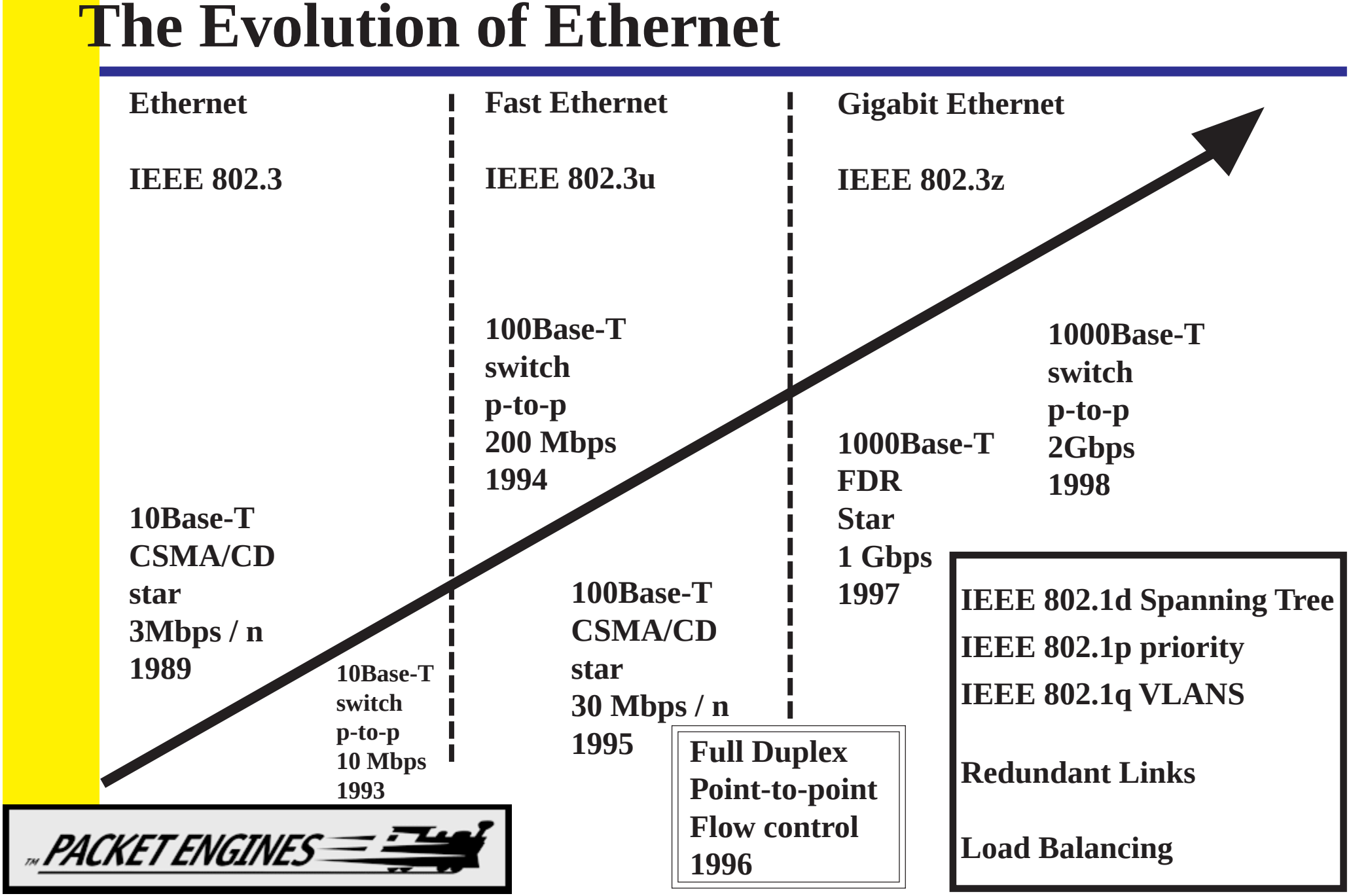
PACKET ENGINES

Features

- Identical Ethernet frames
- Same MAC as Ethernet
- Same IEEE 802.3 CSMA/CD protocol
- Same Full Duplex operation
- 10BASE-T >> 100BASE-T >>
  1000 Base-T
- 1 Gbps throughput (2 Gbps full duplex)
- Uses ANSI Fiber Channel physical layer

PACKET ENGINES

The Evolution of Ethernet



PACKET ENGINES

Gigabit Ethernet drivers

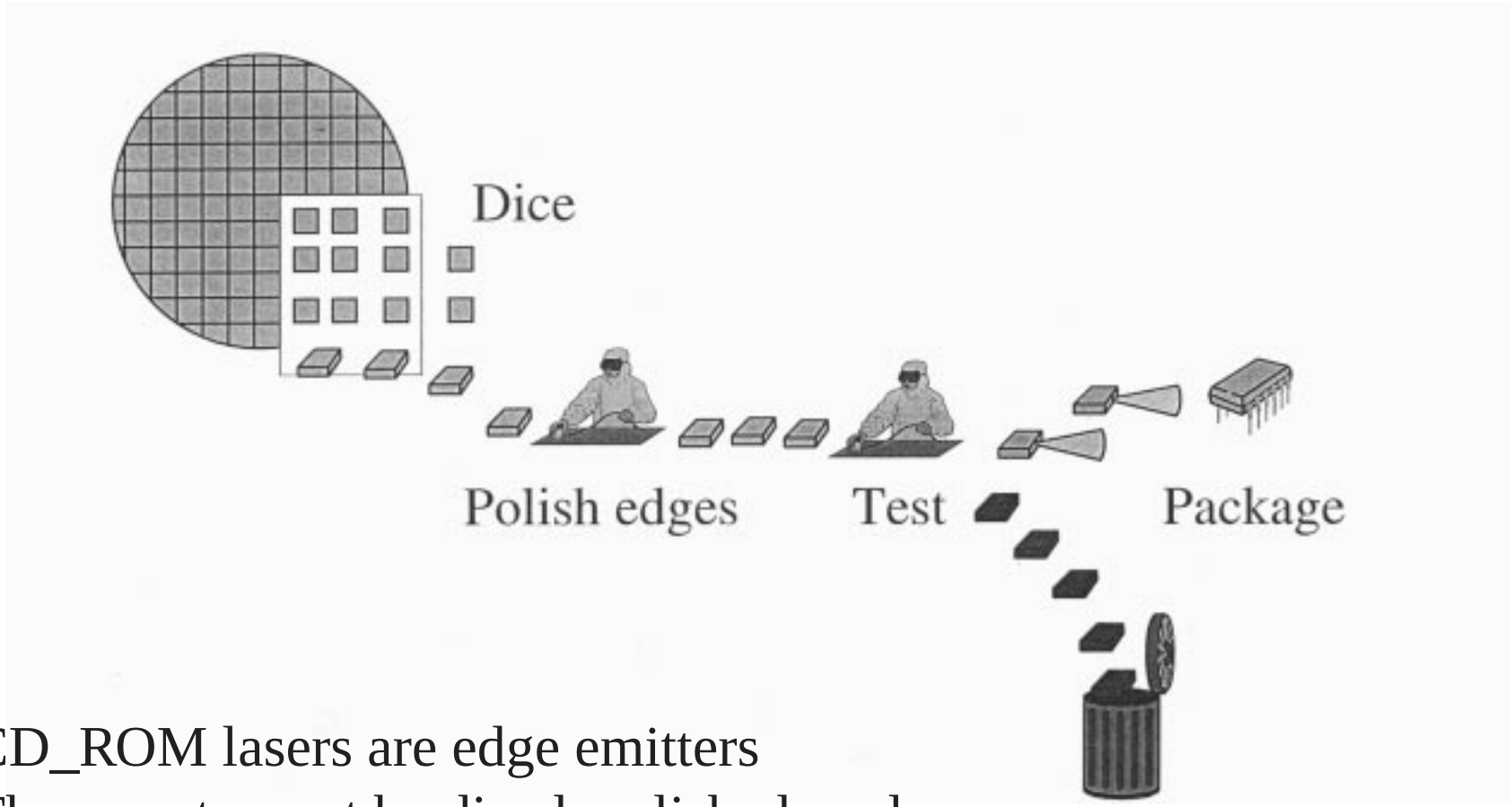
- 25 start-ups
- Rapid progress of standards effort
- Semiconductors
  - Continuing CMOS die shrinkage
  - Better physical chip packages
  - VCSEL laser diodes
- ANSI X3.230 Fiber Channel
- TIA-568 / ISO 11801 Commercial Building Wiring Standards
- Fast packet-switching product architectures

CMOS

Year	fs (um)	tx/cm2 (M)	MHz
1995	.35	4	300
1998	.25	7	450
2001	.18	13	600

PACKET ENGINES

CD-ROM lasers

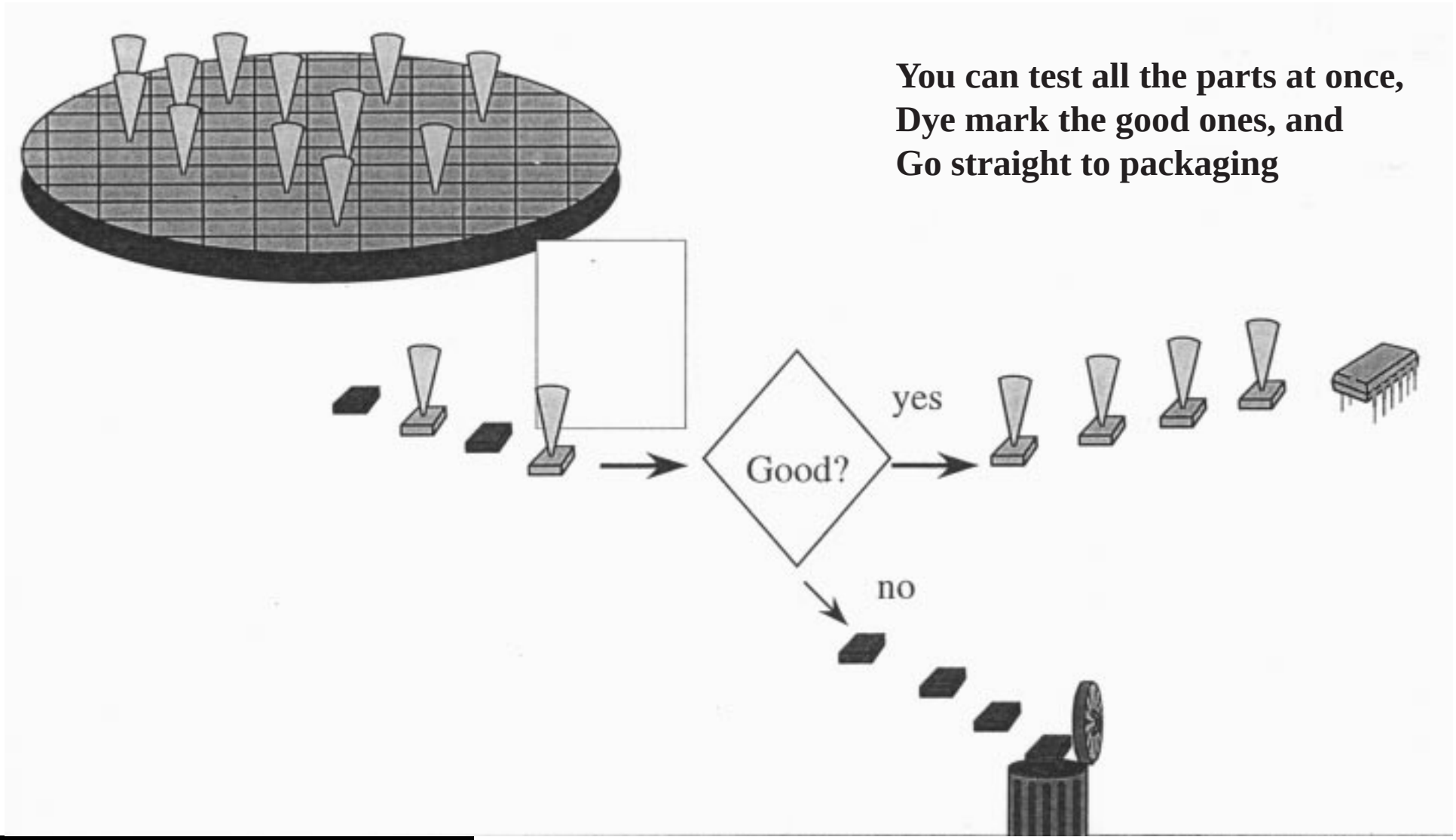


CD_ROM lasers are edge emitters
These parts must be diced, polished, and
individually tested to see if they are any good

PACKET ENGINES

Vertical-Cavity Surface Emitting Laser

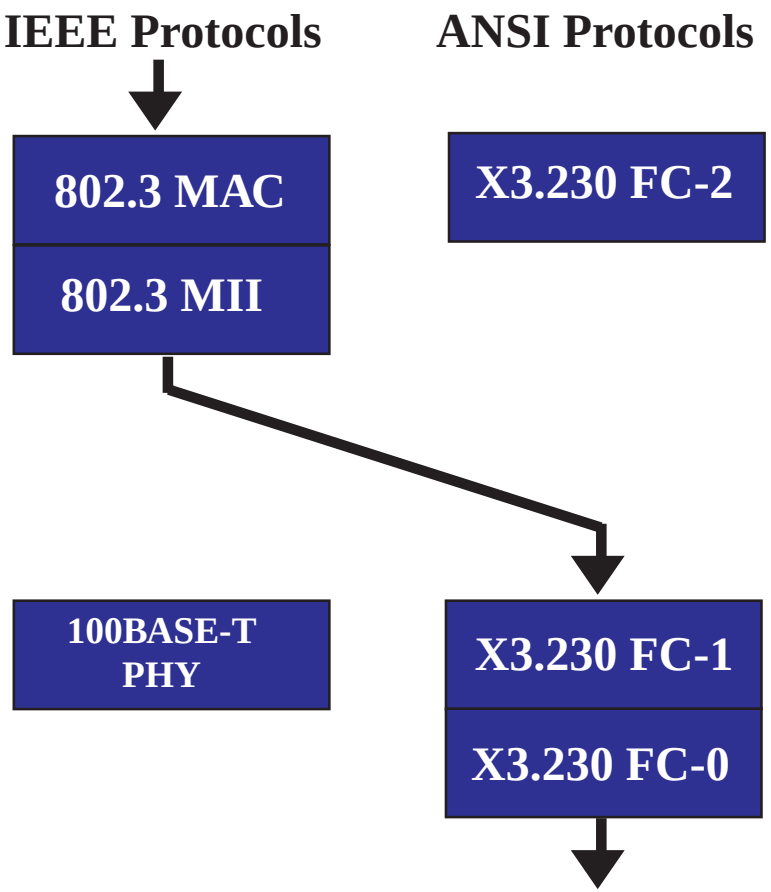
You can test all the parts at once,
Dye mark the good ones, and
Go straight to packaging



PACKET ENGINES

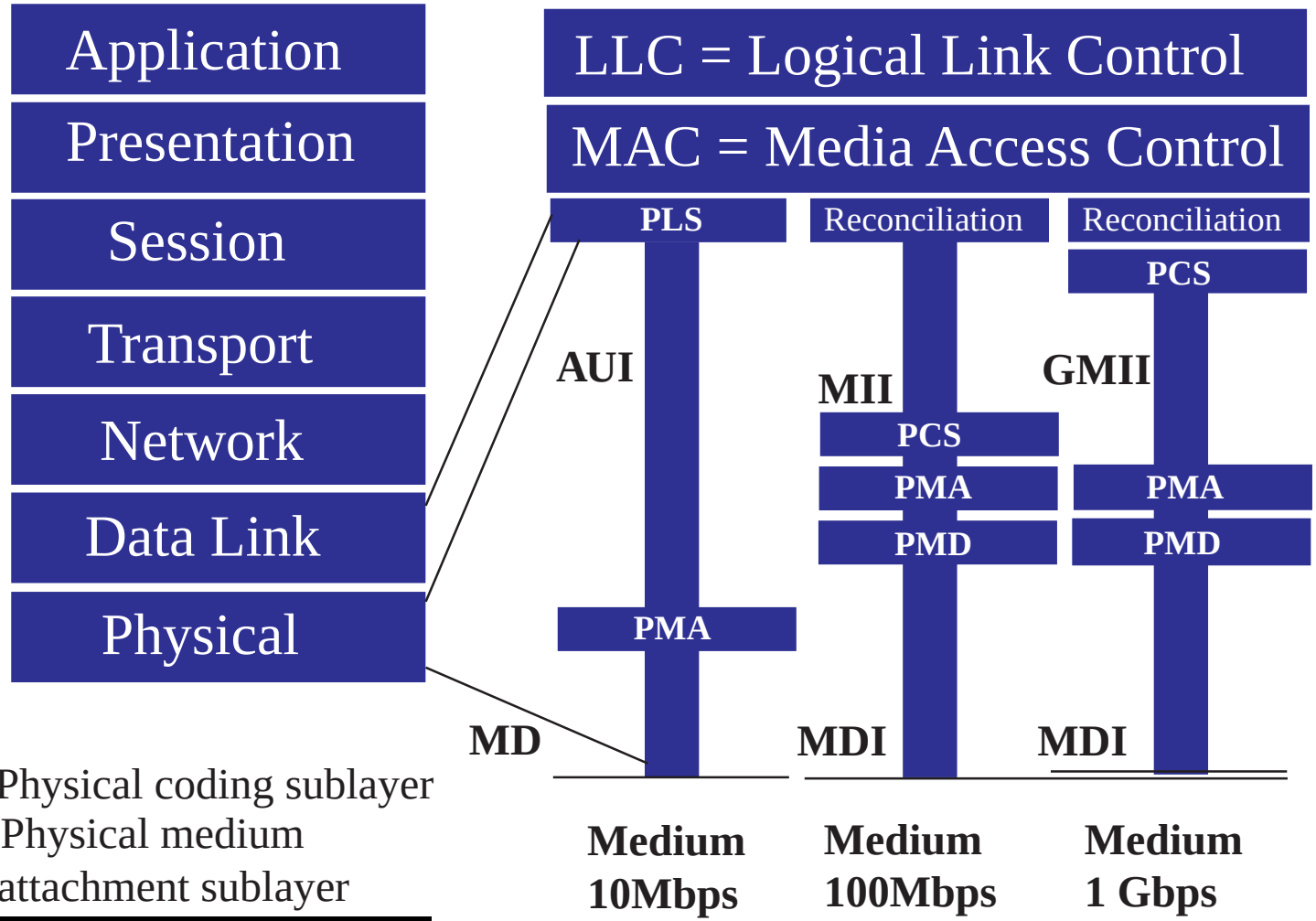
Use of ANSI X3.230 Fiber Channel

- Use 802.3 MAC frame format on the wire
- Base the work on ANSI X3.230 Fiber Channel FC-1 and FC-0 physical level link protocols



PACKET ENGINES

1 Gbps Standards Model



PLS = Physical coding sublayer
PMA = Physical medium attachment sublayer

PACKET ENGINES

1000BASE-T Physical Layers

1 Gbps MAC

Gigabit Media Independent Interface - (GMII)

Backbones
- 62.5 micron
- 1300 Nm lazer

Building
- multimode fiber
- 500 M runs

Campus
- single mode fiber
- 3 kM runs

Horizontal Fiber
- multimode fiber
- 62.5 micron
- 850 nM lazer
- 300 M runs

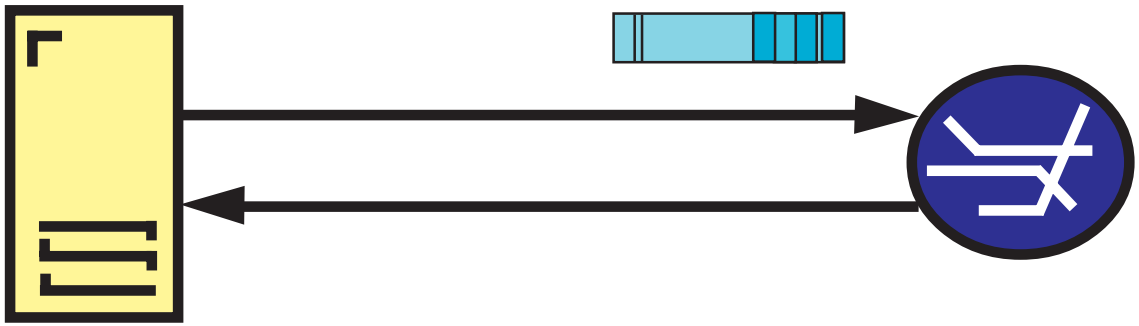
Horizontal Copper
- Cat 5 cable
- 4 pairs
- 100 meter runs
- 1998

Wiring Closet
- copper
- 25 meter runs

PACKET ENGINES

Full Duplex - Flow control

Full Duplex Link

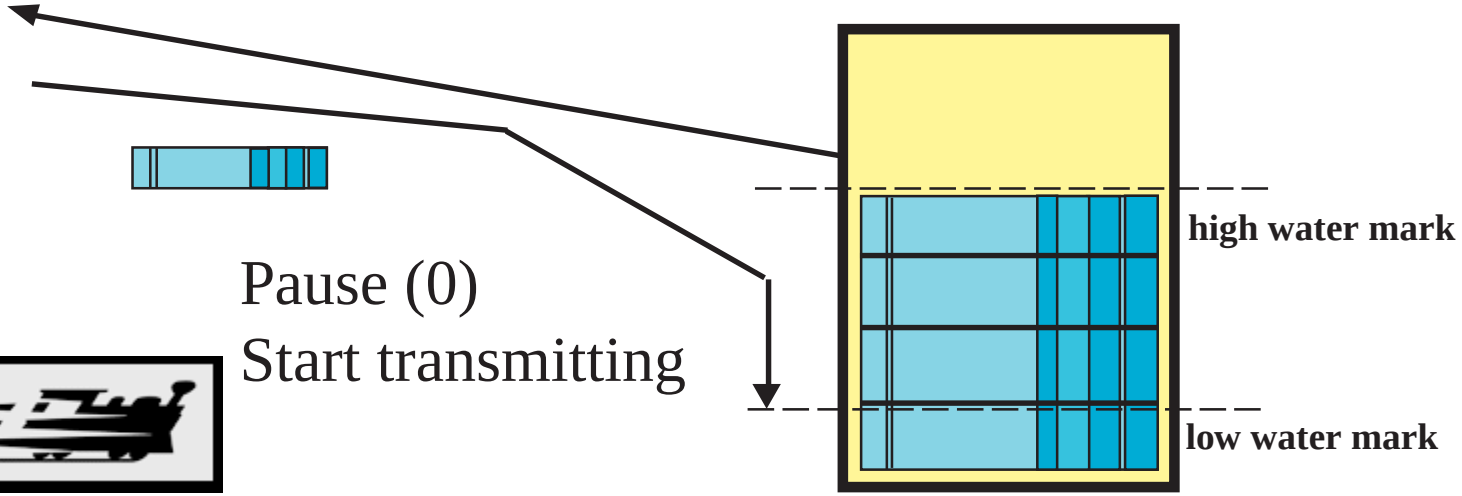


point-to-point
no collisions
1Gbps - each way
no topology constraints

IEEE 802.3x

Flow Control

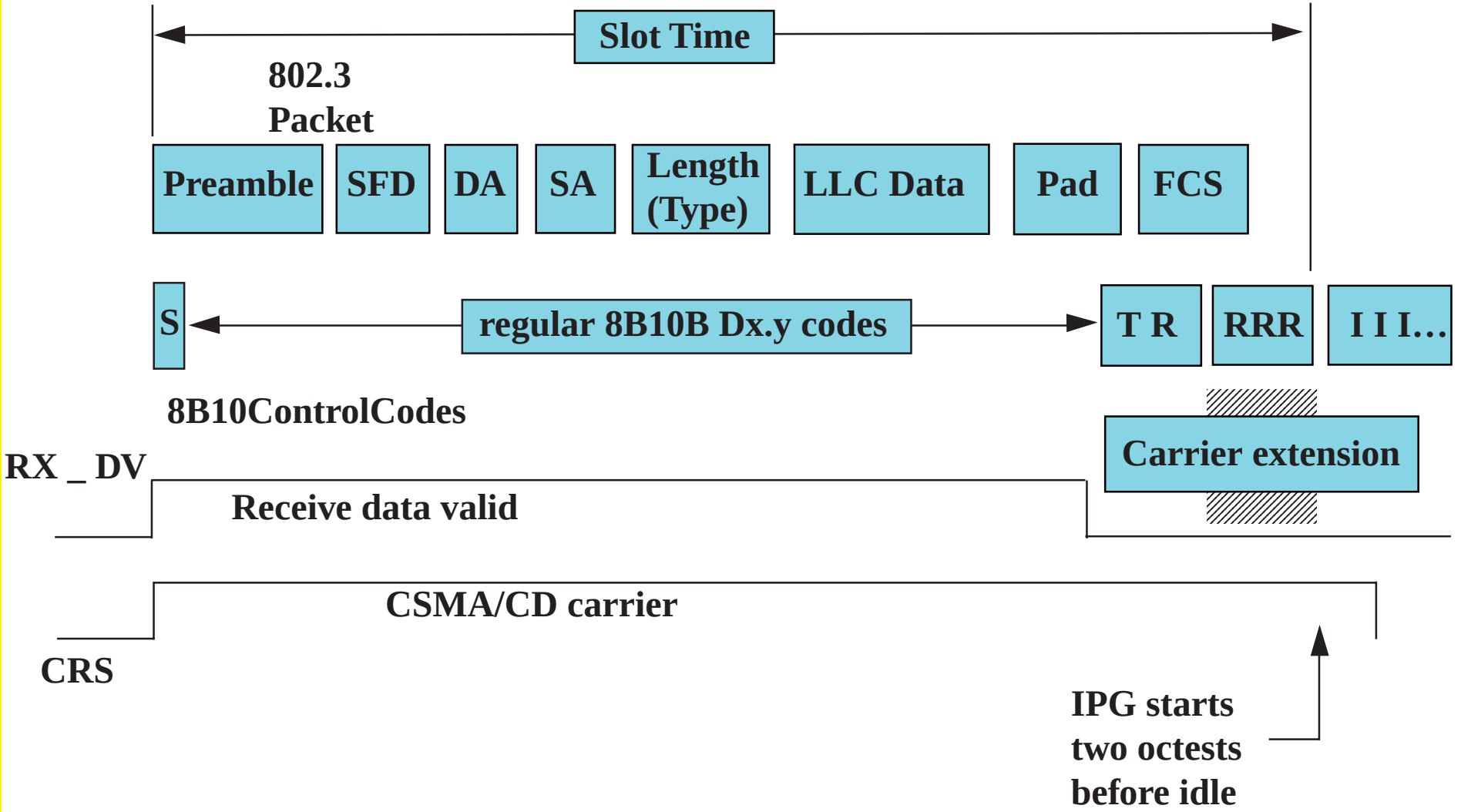
Pause (n)
Stop transmitting



Pause (0)
Start transmitting

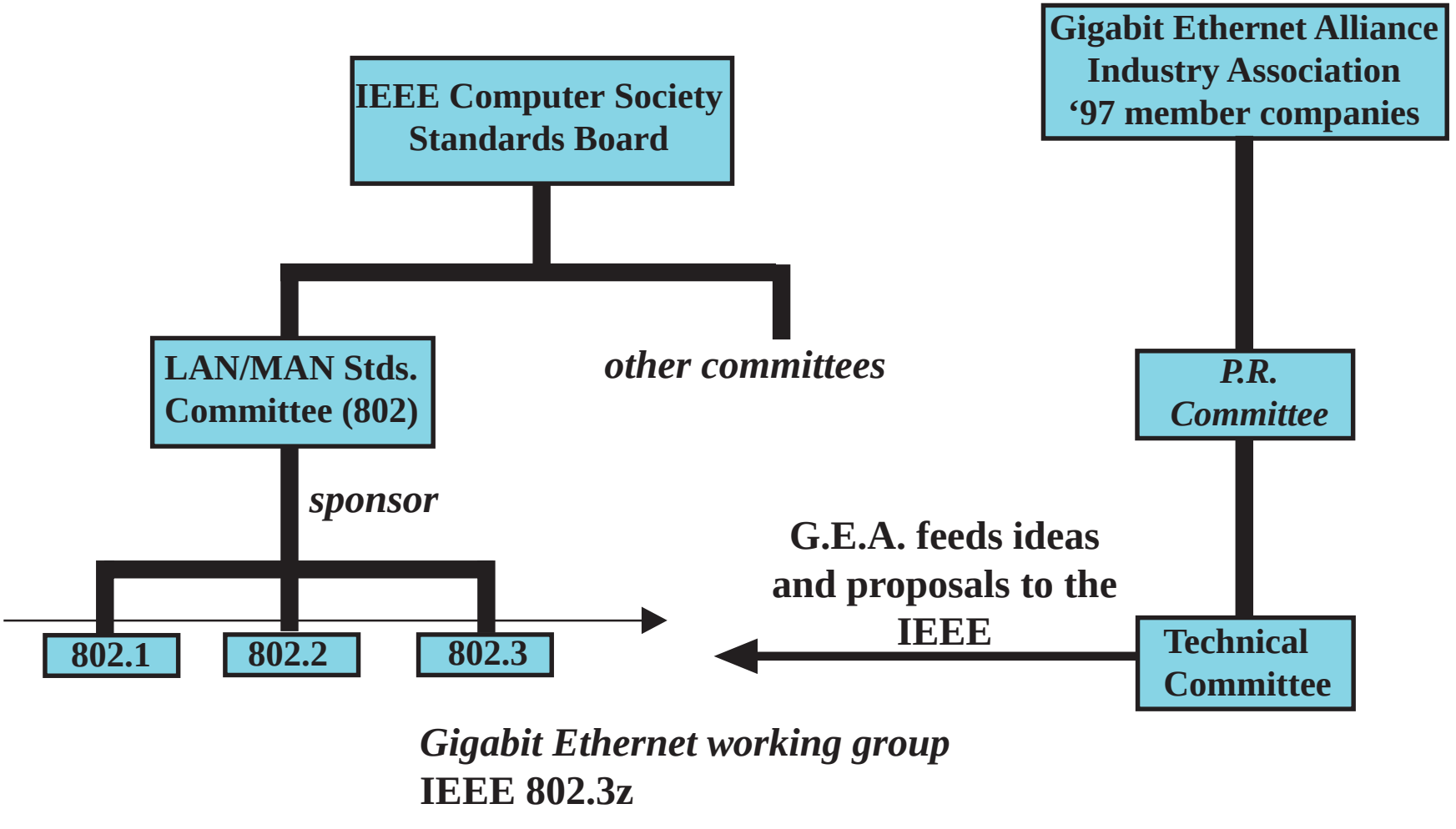
PACKET ENGINES

Frame Format on the Wire



PACKET ENGINES

Development of the Standard



Gigabit Ethernet working group
IEEE 802.3z

PACKET ENGINES

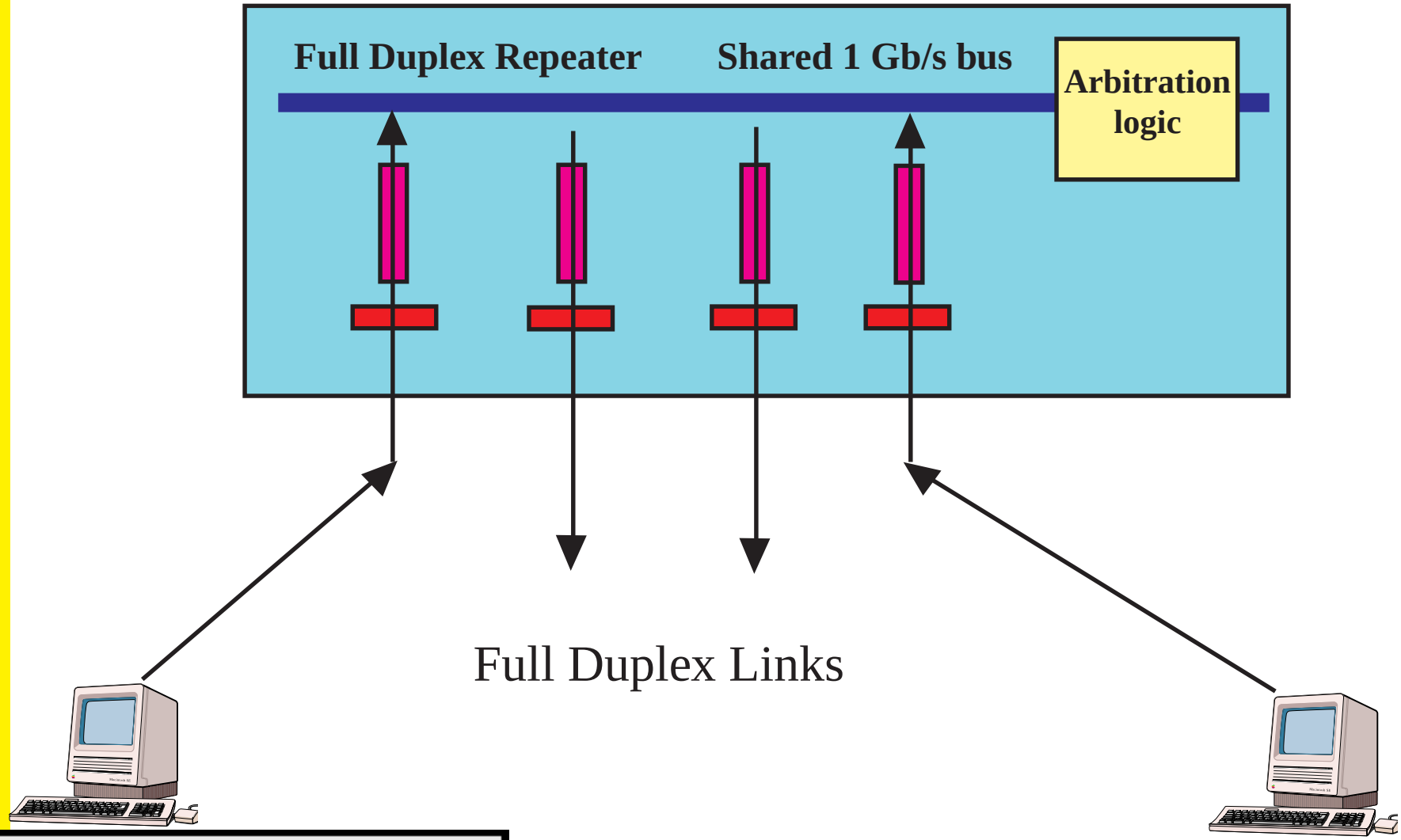
Standard - timeline

- November 9, 1995
  - IEEE 802.3 forms High-Speed Study Group
- May 7, 1996
  - Gigabit Ethernet Alliance formed
- November 10, 1996
  - Technical features frozen
- January 1997
  - Draft standard developed - can build standard compliant products
- July 1997
  - Working group ballot - approval by members
- March 1998
  - Standard published

Gigabit Ethernet Products

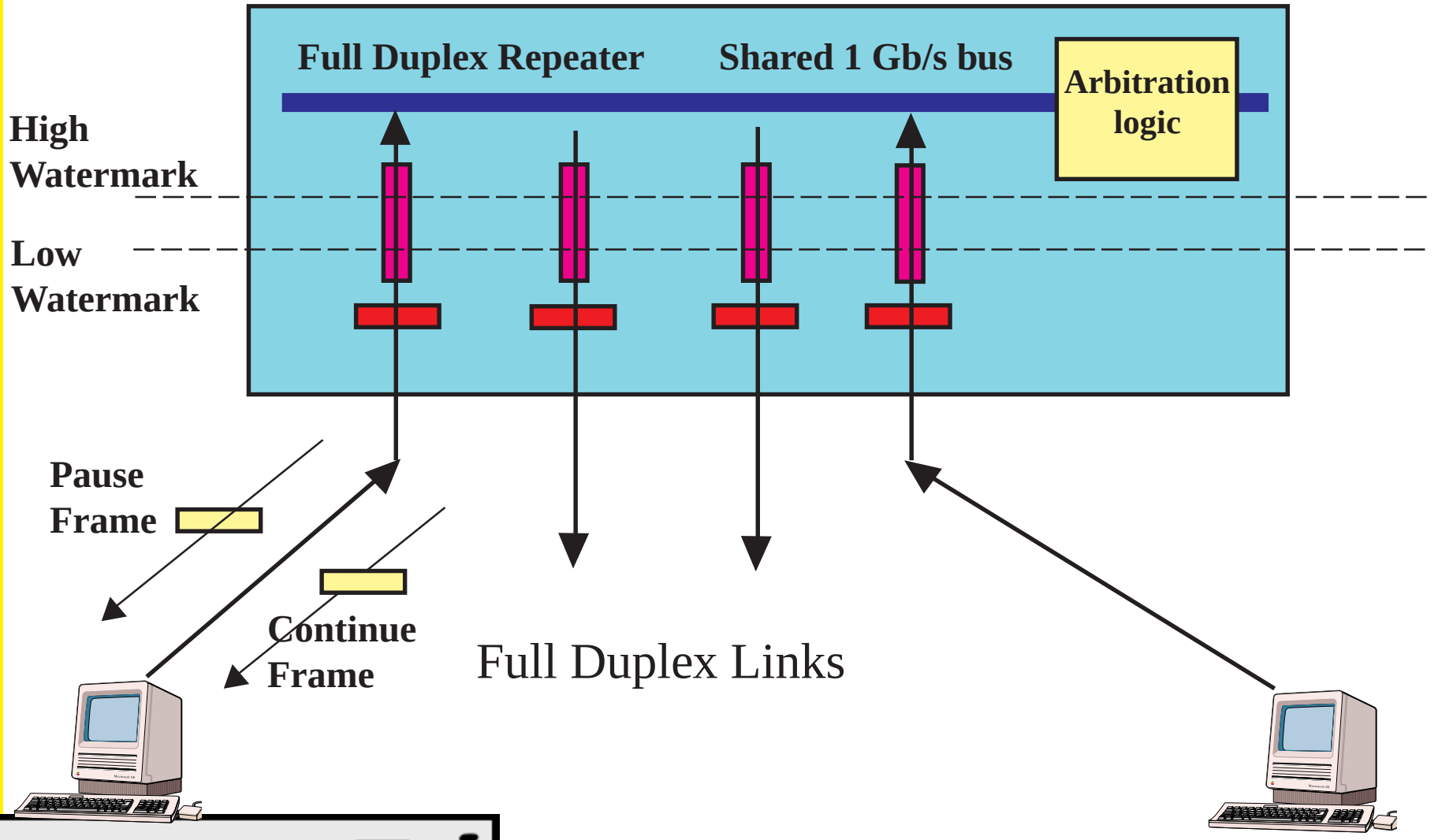
- Adapter cards
- Shared Media hubs
  - 300 - 400 Mbps Aggregate performance
  - 100 meter links
- Full Duplex Repeaters
  - 1 Gbps Aggregate performance
  - links up to 3kM
- Switches
  - High aggregate performance
  - 12-ports, 12 Gbps throughput

Full Duplex Repeaters



PACKET ENGINES

Full Duplex Repeaters - flow control



PACKET ENGINES

Full Duplex Repeaters - summary

- Preserve fairness of CSMA/CD protocol
- Eliminate collision bandwidth
- Allow long link lengths (constrained by optics power budgets only)
- Allow mixing of link lengths
- Can filter runts, fragments and CRC errors
- Low cost v switches

PACKET ENGINES

Packet Engines

- Founded in 1994 by Bernard Daines
- Launched 1 Gigabit Ethernet initiative
- Developing a family of Gigabit Ethernet System Products
- Equity Investment by Battery / Mayfield
- $7.5M round
- 70 Employees

PE Gigabit Adapter Card

- Full Duplex (2 Gbps throughput)
- Large transmit & receive FIFOs
- IEEE 802.3x compliant
  - Full duplex with Flow Control
- IEEE 802.3z compliant
- PCI bus interface (1/2 height)
- 64-bit, 33 MHz
- Fiber optic interface
  - SWL & LWL options

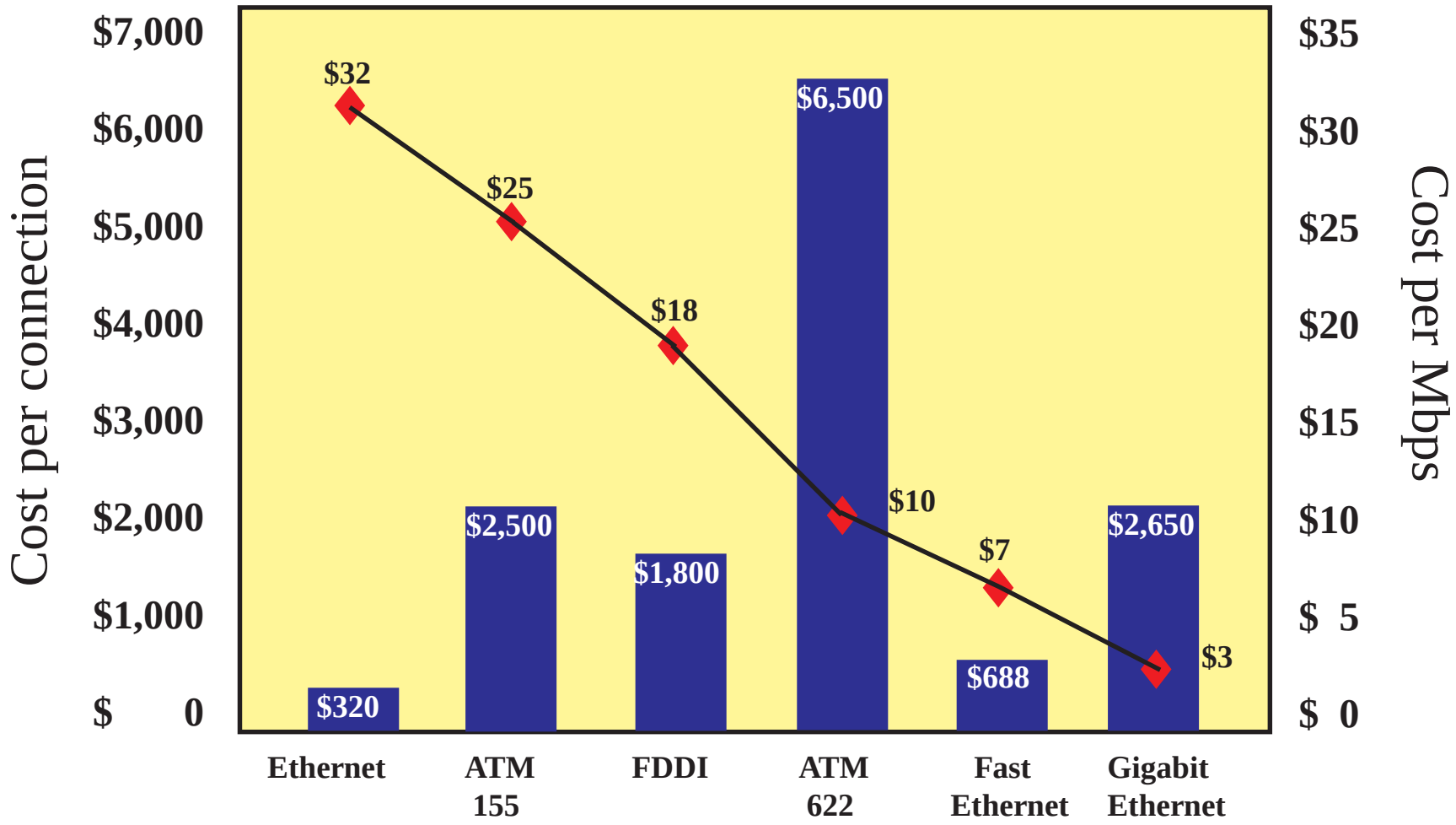
PACKET ENGINES

PE Full Duplex Repeater

- 12 fiber ports (SWL) - 1 Gbps
- 1 Uplink port - 1 Gbps
- 10/100 Mbps Legacy port
- Legacy to Gigabit bridge
- IEEE 802.3x compliant
  - Full Duplex with Flow Control
- IEEE 802.3z compliant
  - Gigabit Ethernet draft standard

PACKET ENGINES

Technology Cost Comparison



PACKET ENGINES

Summary of Gigabit Ethernet Advantages

- Preserves all the features of Ethernet
- Ten times faster than 100Base-T
- Spans workgroup, building or campus
- When combined with switching technology allows six classes of service
- Network management MIBs and tools unchanged
- Same applications run transparently (just faster)
- No re-training for MIS and LAN administrative staff
- Allows gradual migration, preserving existing investments while “future proofing” current acquisitions
- Low cost, high performance solution